Transportation
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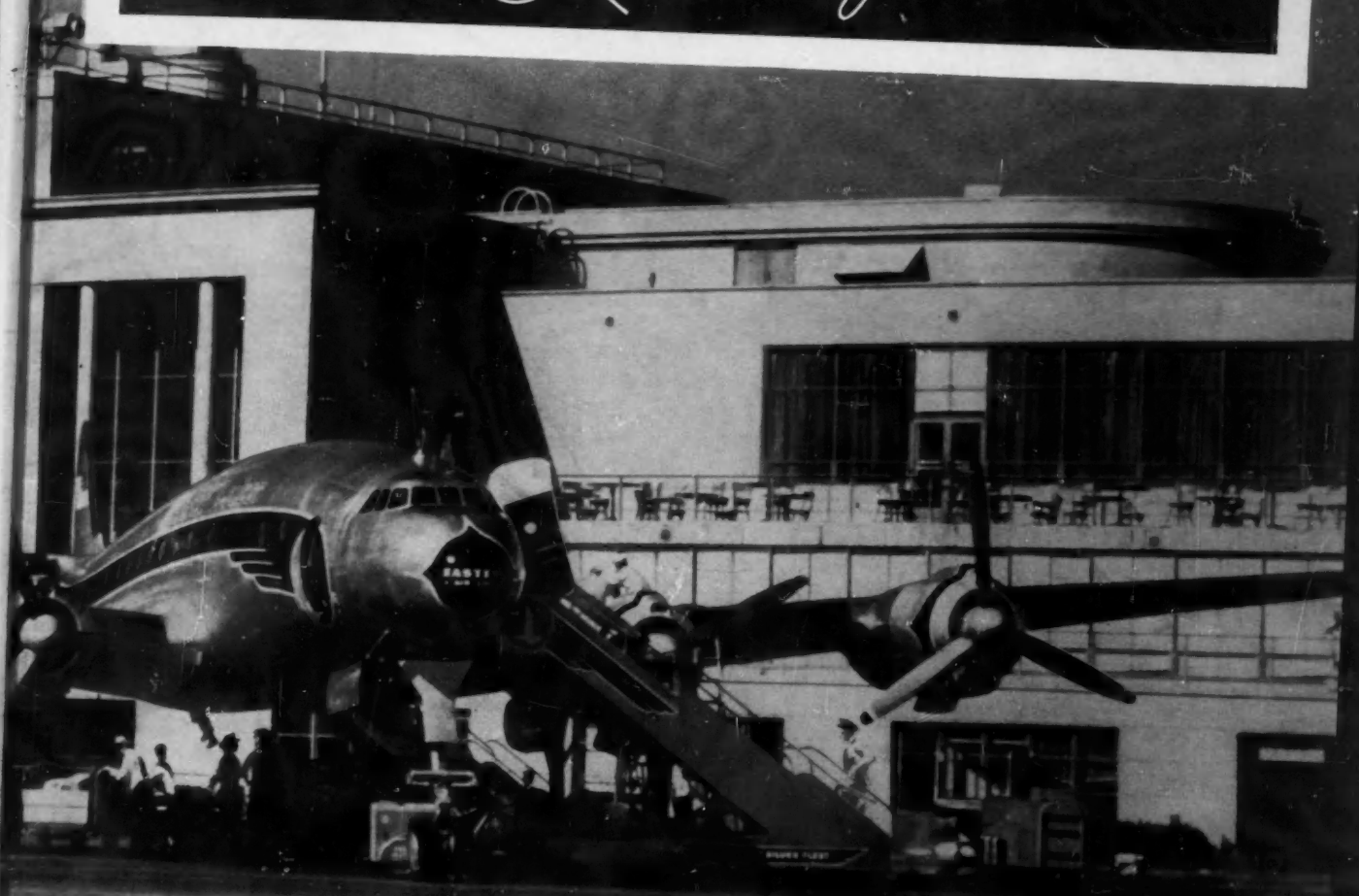
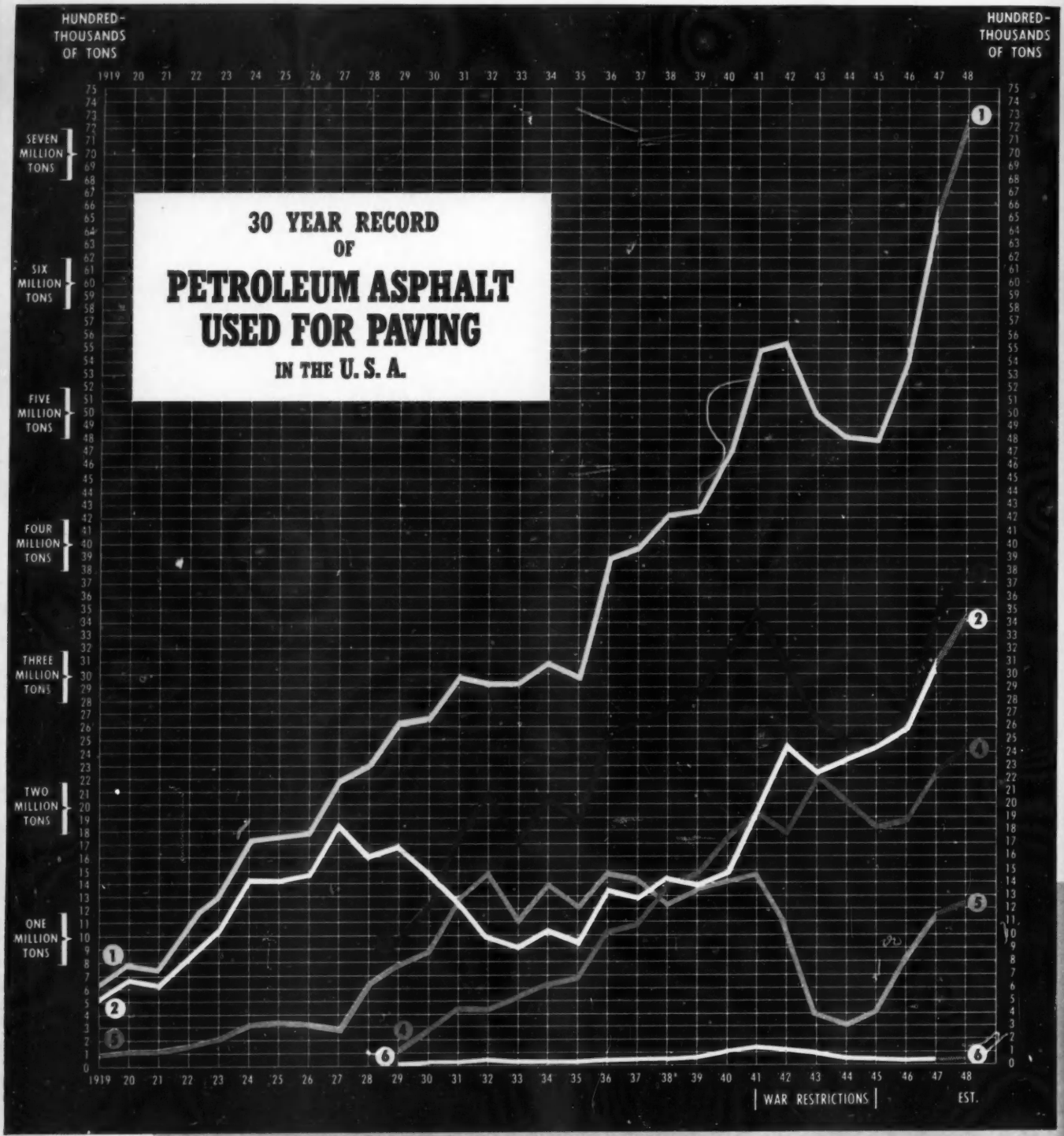
# Aspects Quarterly




HUNDRED-THOUSANDS OF TONS
HUNDRED-THOUSANDS OF TONS
30 YEAR RECORD
OF
PETROLEUM ASPHALT
USED FOR PAVING
IN THE U. S. A.
SEVEN MILLION TONS
SIX MILLION TONS
FIVE MILLION TONS
FOUR MILLION TONS
THREE MILLION TONS
TWO MILLION TONS
ONE MILLION TONS
1919 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
WAR RESTRICTIONS
EST.

**KEY**

1. TOTAL FOR PAVING (ALL GRADES) = (2+3)
2. PAVING CEMENT AND FLUX
3. LIQUID GRADES (EXCEPT FLUX)= (4+5+6)
4. CUT BACK ASPHALT
5. ROAD OIL
6. ASPHALT EMULSION (Emulsion by "Non-Producers" not included)

SOURCE: U. S. BUREAU OF MINES ANNUAL FIGURES

CHARTED BY THE ASPHALT INSTITUTE 11/48

# Quarterly

The Asphalt Institute Quarterly is published by the Asphalt Institute, a national, non-profit organization sponsored by members of the industry for the purpose of promoting interest in the use of asphaltic products.

The names of the Member Companies of the Institute, who have made possible the publication of this magazine, are listed herein on page 15.

*Articles may be freely reprinted with credit line. Correspondence should be addressed to the Asphalt Institute Quarterly, 801 Second Avenue, New York 17, N. Y.*

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## COVER

Featured on the cover, through the courtesy of Civil Aeronautics Administration, is the Washington National Airport. This model in the design of commercial airports, adjacent to the Potomac River, two miles south of the Washington Monument, is paved with heavy duty runways of asphaltic concrete. Its pavement design is described on page 7.

Featured on the opposite page is a graphic chart illustrating the steady growth in the use of petroleum asphalt for paving during the past thirty years. How this chart may be interpreted in terms of *asphalt mileage* built is graphically shown on page 14.

Transportation Library

# EDITORIAL

With this issue, the Asphalt Institute inaugurates a new publication of nationwide distribution, designed to make widely available information relative to the economic and technical advantages of asphalt. By reference to the chart on the opposite page, it will be observed that a sharply upward trend in the use of asphalt for paving has accompanied the rapid development of motor vehicle transportation during the past thirty years. Today, the automobile and the truck literally ride on asphalt, for most improved roads and streets, over 500,000 miles in the United States, — are paved with this essential product.

There are other varied and expanding uses for asphalt, such as the paving of airfields, pavement of recreational areas, protection of river banks against erosion, lining of irrigation canals to prevent water loss, and stabilization of railroad roadbeds, to name but a few. From time to time, it is planned to devote an entire issue of the *Asphalt Institute Quarterly* to a single phase of such works with detailed description of current practice throughout the country, together with reports on research projects underway on the same subject.

In the article in this issue on "Future Trends in Highway Development," particular attention is drawn to the great *savings* that are possible through the even wider use of asphalt on the highway systems. With imposition of taxes approaching the point of saturation, if not already there, it is obvious that *full use* of the highway facilities we have must be a first consideration; and that the adoption of methods by which existing pavements can be made to serve for decades to come, *by reasonable additions rather than replacements,* is something in which every public official cannot fail to be interested.

The *Asphalt Institute Quarterly* replaces the "Asphalt Forum," which was published so effectively by the Pacific Coast Division of the Asphalt Institute during the period 1937 to 1948 inclusive, the last issue being Volume XI, No. 3, November, 1948.

To make this magazine of the greatest possible use, suggestions and comments will be most welcome. These may be sent to the Editor c/o The Asphalt Institute, 801 Second Avenue, New York, N. Y., or to the nearest Asphalt Institute office. Particular attention will be given to questions, and those where the answers are of general application will be treated in subsequent issues of the Quarterly; while in other cases where the subjects are of more local interest, replies will be handled through individual correspondence.

Engineering and research organizations of industry, such as the Asphalt Institute, are a development particularly characteristic of the United States. Such organizations, by developing industrial knowledge and techniques and making them promptly available for widespread uses beneficial to the consumer, have had a profound influence on the rapid growth of this country. Through the medium of the *Asphalt Institute Quarterly* it is hoped to disseminate even more widely useful knowledge in regard to the utilization of asphalt, one of nature's most versatile products.

# FUTURE TRENDS IN HIGHWAY DEVELOPMENT

by BERNARD E. GRAY

CALIFORNIA'S ASPHALTIC CONCRETE. Five thousand miles of its splendid State Highway System are surfaced with high-type asphalt pavement.

With taxation increasing, and costs of all kinds permanently on a much higher level than pre-war, highway officials are confronted with a financing problem of the first magnitude. New cars and trucks have nearly made up for the production lag of the war years, and in addition each motor vehicle is operated over greater mileage per year, so that the net effect is more travel than at any previous period in history. In contrast, our highway system has had severe overloading, with minimum maintenance, for nearly six years. While it is indeed a credit to the roadbuilders of the past three decades that this system has served so well during an extremely trying period, there is no doubt that its general level of serviceability has deteriorated to a considerable degree.

There is some disposition on the part of those not familiar with the history of highway building, to take the critical position that present congestion is due to basic faults in orig-

MERRITT PARKWAY, CONNECTICUT. Opened in 1938, in 1948 on two one-mile sections near Stamford the rigid type pavement was resurfaced with 2 inches of asphaltic concrete.

SOUTHERN STATE PARKWAY, LONG ISLAND, NEW YORK. Opened in 1930, in 1948 on a three-mile section near Baldwin, the rigid type pavement was resurfaced with 2½ inches of asphaltic concrete.

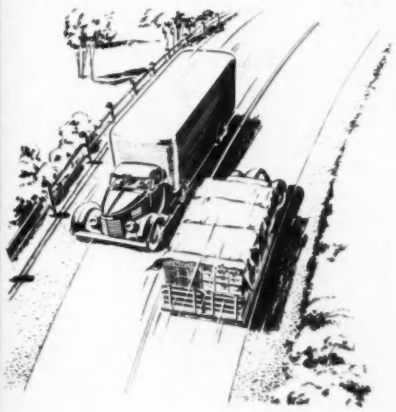
inal design. In fact, it has even been asserted that the entire road network of the United States is obsolete, and that it will require complete rebuilding. Such statements are absurd. The situation is more nearly parallel to that of the house owner who for one reason or another has not painted or made minor improvements in his property, either because of lack of materials or too high costs. Basic values are unaltered, they require only additions to meet new conditions of use.

## AN IRREPLACEABLE HIGHWAY SYSTEM

The highway system of this country is a splendid thing. There is nothing to compare with it in any other part of the world. Upon it has been expended nearly thirty-five billion dollars, and it could not be duplicated for twice this sum. *It probably could not be duplicated at all for any amount of money,* because into its construction and maintenance has gone age-long accumulations of gravel, the low cost production of stone, timber, steel and all the other materials that are no longer available from nearby sources.

## OVERCOMING DEFICIENCIES

What really is our present difficulty? Analysis would indicate that it consists of two parts; one, we do not seem to have enough room on many highways, and the other, some highways have become weakened under wartime overloading. To overcome these deficiencies there appear to be developing two opposing concepts. Supporters of one argue that construction money should be expended largely upon a limited system of new, relocated expressways in and around the metropolitan areas, while the second group believes that the present roads should be made more efficient by a process of widening and resurfacing which will in effect produce a new highway system. In light of the great success which has attended the latter procedure wherever it has been employed, it would seem the part of wisdom *to utilize what we have to the fullest extent before we talk about complete replacement.*



## COORDINATION NEEDED

In respect to lack of room on our highways, a considerable measure of this shortage comes about from lack of coordination between the motor vehicle builder and the road builder. Some 50% of all improved surfaces are 18 feet or less in width. While adequate for two-lane traffic when originally built, they are now too narrow because trucks have been widened to 8 feet (with great demand being made for 8½ feet) and passenger cars to 6½ feet. It is readily seen that in any combination of mixed traffic there just is not enough room for free movement of such size vehicles. The remedy obviously is to widen these narrow pavements, and to strengthen them, where necessary, by placement of an additional surface. Asphalt paving mixtures, by reason of their adaptability to variable conditions, appear to be the most useful and economical materials to accomplish these ends.

## WIDENING AND RESURFACING WITH ASPHALT

Already, thousands of miles of all types of old pavements have been resurfaced and widened. They include portland cement concrete, brick, block, as well as all bituminous types and,

from the experience gained, requisite reconstruction fundamentals have been soundly established. In many States, old portland cement concrete roads are undersealed with a high melting point asphalt cement prior to resurfacing, which fills all cavities under the pavement and insures greater foundation support.

Widening to 24 feet is desirable for present-day traffic, as this width permits sufficient lateral movement, not only for passing slow moving vehicles, but for reduction in load concentration on a single narrow lane as well. There has been a recent great improvement in the technique of placing the widened area. Special trenching equipment excavates the earth shoulder to the exact width and depth required without disturbance to lateral or bottom subgrade support. The dirt removed is piled neatly on the side away from traffic and readily redistributed as required. Similarly for placement of the widened pavement, special narrow wheel rollers are employed, so that as completed the degree of compaction has been sufficient to provide against settlement.

Sometimes widening is accomplished a year or more in advance of overall resurfacing and where the existing pavement is sufficiently strong and unbroken, this procedure may have merit. However, in most instances, some strengthening and waterproofing also is needed, and placement of the new asphalt surface follows a few weeks after the widening is completed.

No matter how thin the resurfacing, it should be placed in two or more layers, both because of the greater smoothness resulting, and also because of the more uniform and complete sealing of the old surface. Marked advances have been made in the mechanical spreading equipment so that machines can be adjusted in width of spread while in motion. This means quicker change so that successive layers are placed with staggered longitudinal joints, thereby insuring a finished surface free of any joints whatever.

## A PRACTICAL ECONOMY

All these developments have had a real influence on cost, and have tended to offset the advances required for labor and materials. For example, an entirely new, heavy-duty pavement 24 feet wide, exclusive of right-of-way grading and drainage, costs from $35,000 to $70,000 per mile, depending upon location. In contrast, widening and resurfacing of existing pavements to the same width seldom costs over a third of these amounts, and yet provides an adequately improved highway of the needed kind.

There is a great present need to place under contract large amounts of work of a kind that will become *immediately* useful. New locations require much time to obtain rights-of-way and to prepare the elaborate plans that are considered necessary. In contrast, a widening and resurfacing program can be expanded in a very short time. There are required only a few typical cross-sections, a small amount of field work, and thousands of miles of highways can be placed under reconstruction within a few months.

We cannot afford to tear up or abandon a single foot of the pavements we now have, merely because they are narrow, or cracked, rough and uneven, when rehabilitation can be accomplished at such savings. It would hardly seem to be good business for American taxpayers.

Courtesy

MARYLAND, U. S. 40, west of Havre deGrace — Resurfacing rigid type pavement with asphalt.

TEXAS, U. S. 80, east of Dallas. Two lane rigid type pavement being widened to three lanes, with hot-mix asphalt base and hot-mix asphalt surface course over the entire width.

Courtesy of T W A

WASHINGTON NATIONAL AIRPORT: Constellation landing on asphalt runway. This pavement consists of 3½ inches of asphaltic concrete, in two courses, on a 9 inch gravel base. In nearly eight years of continuous, heavy-duty operation, the asphalt-surfaced runways of this entire airport have required practically no maintenance or repair.

# Asphalt Airfield Paving

The United States today has close to 6,000 airports of all types, of which about 1,250 have been paved. This total figure represents an increase of approximately 2,000 airports in the past five years, due to the tremendous growth in commercial and private flying.

In the next three years, in line with the current Federal-Aid national airport plan, the Civil Aeronautics Administration estimates that about 2,100 existing airports should be improved and that 3,000 new airports should be built, with an overall estimated expenditure of more than a billion dollars.

While most of these airports will be small with sodded runways, there is still involved many thousands of miles of pavement. The larger, heavy duty airfields of the present, for paved runways, taxiways, loading aprons, access and service roads, each require the equivalent of about 100 miles of highway 18 feet wide. Of the lighter pavement the Oklahoma City Airpark, pictured here, required the equivalent of nearly 10 miles of such highway.

The majority of all paved airports are asphalt, and the new ones to be built, or the old ones which will be strengthened, will continue to be largely of asphalt due to the initial economy, low maintenance expense, and ease of extension and strengthening whenever future traffic makes such steps necessary.

A great advantage of asphalt lies not alone in its durability and waterproof character but also in the fact that it can be used as a surfacing over crushed stone, gravel, cinders, or any one of a number of other *local* natural materials, which so surfaced provide strong and lasting bases.

As in the development of highways, in the building of the airport network of the future there is need for "stage" construction. The small airpark for its light planes can be economically surfaced with a thin asphalt treatment, while most of the huge airfields with one and two-mile long runways will be paved with heavy-duty, asphaltic concrete.

**INSTITUTE AIRFIELD MANUAL AVAILABLE**
An Asphalt Institute publication entitled "Manual on Airfields," including design, construction, and maintenance recommendations, is available at the printing cost of 70c per copy. In writing any Institute Office ask for Construction Series No. 79.

Canal-lining machine paves with asphaltic mix, delivered by clam-shell bucket.

*Courtesy U. S. Bureau of Reclamation.*

# Progress in Developing ASPHALT CANAL LININGS

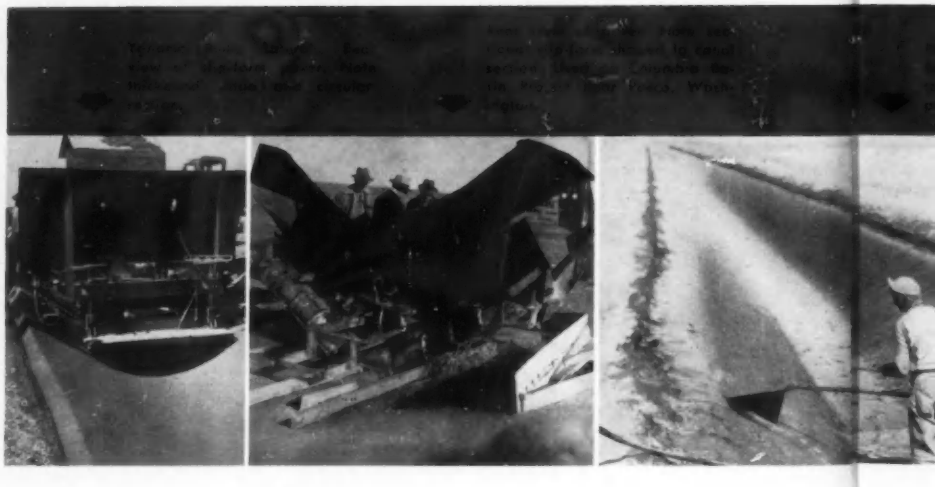
Pasco Pump Lateral, Columbia Basin Project, Washington.

Weighted Slip-Form of paver. Pasco Pump Laterals, Columbia Basin Project near Pasco.

It is being developed that asphalt can be the best protective lining for the 125,000 miles of main and lateral canals that carry water to *seventeen* Western States. To date, less than 5,000 miles, or 4%, of this vital network have any effective lining, chiefly because construction costs have been prohibitive.

## SEEPAGE LOSSES CRITICAL

Thousands of miles of irrigation sections in these States fail to deliver a large proportion of the water turned into them at their intakes because of leakage from unlined canals. It has been estimated that one-third of all water diverted in western streams is lost in transit to the farmland. Of the 14,600,000 acre-feet of water diverted for use in thirty-six U. S. Bureau of Reclamation projects during 1946, approximately 37% was lost in transit. More than half of the transit loss, or 23% of the total water diverted, was attributed to seepage from canals and laterals. Assuming three acre-feet of water per acre, 23% of water lost through seepage, on these few projects alone, would adequately irrigate



Ygnacio Pump Laterals, Central Valley Project near Concord, California. Front view of paver.

an additional one million acres.

Huge seepage losses, however, are affecting hundreds of millions of acres. They can be reduced only through providing a really impervious conduit for the water. In open channels this can be accomplished either by constructing a lining or by special treatment of the canal section. Linings of various types have been installed in numerous canals in the past, but only where conditions made lining imperative or where the lining could be immediately economically justified.

## EFFECTIVE CANALS AT LOWER COSTS

During the past few years, through laboratory research and field installations, the use of asphalt for canal linings has been developed to solve the serious seepage loss problem effectively and at lower costs. The wide range of characteristics of asphaltic materials is now making available a variety of lining types *combining suitably differential costs with permanence and durability.*

The larger canals call for heavier designs and for these the expense of asphaltic concrete is always justified. Through many years of successful performance, — in fact through the Ages, this type of lining has established itself in the field of hydraulic control as a proven method of construction.

The smaller, much more numerous canals of the network, however, are quite limited in respect to permissible cost and it is here that the need for improved construction methods is most acute.

Three practical asphaltic types, designed to meet this critical need, are the asphalt prime membrane, the asphalt buried membrane, and the asphalt prefabricated canal lining. These are briefly described herewith.

## PRIME-MEMBRANE CANAL LINING

Prime-membrane types of asphaltic canal linings are demanding greater consideration in the field of low-cost linings due to their promising service behavior in field trials. In this type of lining, permeable soils usually of a sandy or sandy-silty nature, are preprimed with a medium viscosity oil, followed by a prime of a low viscosity cut-back asphalt, and finally sealed with a mineral filled, heavy paving grade asphalt; or an air-blown asphalt which may or may not contain mineral filler.

## BURIED MEMBRANE CANAL LINING

Buried asphaltic membranes, as the name implies, are asphaltic seals which are covered with earth, sand, gravel, cobbles or other erosion-resistant and protective material. These linings are placed primarily for the purpose of controlling seepage and leakage, particularly from those canals and laterals which are constructed in permeable sandy or gravelly soils; or where faulted and fractured shales or similar materials are encountered. The asphalt membrane, protected from air and actinic solar radiation, may be expected to endure for many years.

## PREFABRICATED CANAL LINING

In general, prefabricated asphalt canal linings consist of impermeable asphaltic mixes or mastics applied to various types of fabrics as a backing or core, manufactured at a central plant, transported as a finished product to the canal and laid in place. They may be made in the form of blocks, sheets or rolls. These prefabricated linings are valuable in lining small laterals, particularly so to the individual farmer who can place the linings himself in the off-season at low labor cost.

Among those who have been close to the problem of low cost canal linings for some time, the opinion is unanimous that some single package, low-cost form of prefabricated lining offers a wide field for the solution of numerous phases of water conservation and control.

### INSTITUTE PUBLICATION AVAILABLE

An Asphalt Institute publication, "Asphaltic Canal Linings," including recommendations based upon tested principles and practices developed to date, is available at the printing cost of 40c per copy. In writing any Institute Office, ask for the booklet, "Construction Series No. 86."

# PREVOST HUBBARD

## Dean Emeritus of Asphalt Research

Prevost Hubbard is widely known throughout the highway field, both here and abroad, as the director of research and laboratory studies of the Asphalt Institute for the nearly thirty years since its inception in 1919. His work has helped greatly toward providing the sound, scientific background required throughout this road-building era. In these thirty years, hundreds of thousands of miles of roads and streets in the United States have been paved with asphalt, — most of them new construction, the rest the modernizing of other surface types.

### WITH "U. S. PUBLIC ROADS"

Back in 1905, in the pioneer days of the present vast highway system, Mr. Hubbard joined the then "U. S. Office of Public Roads" in Washington, D. C. as Assistant Chemist and, in a "Public Roads" career dating from 1905 to 1911 and from 1915 to 1919, advanced successively to Chemist, Chief Chemist, Chemical Engineer and Chief, Division of Road Material, Tests and Research. In the intervening years from 1911 to 1915 he was engaged as Consulting Engineer in charge of the Division of Roads and Pavements for the Institute of Industrial Research, testing and supervising the use of all road material.

### ASPHALT INSTITUTE CAREER

Mr. Hubbard's coming from the Bureau of Public Roads to the Asphalt Institute in 1919 marked the beginning of a new, long chapter in his record of research activities, extremely beneficial nationally to both highway development and the asphalt industry.

He took a leading part in shaping Institute cooperation with "U. S. Public Roads" in the simplification and coordination of the Specifications of the Highway Departments of the various States. He supervised the cooperation of the Institute in working with the U. S. Department of Commerce in successfully reducing the number of paving grades of asphalt from one hundred and two to nine, putting the marketing of the product on a sound economic and more serviceable basis.

Through research work in the Institute Laboratory, in cooperation with "U. S. Public Roads," there was produced a new type of liquid asphaltic product known as Medium Curing Cut-Back Asphalt, now widely used throughout the United States, particularly suited to *low-cost* road construction.

### HUBBARD-FIELD STABILITY TEST

An important contribution to improved asphalt pavement design is known as the Hubbard-Field Stability Test (Prevost Hubbard and F. C. Field, Chemist of the Asphalt Institute.) In 1925, when dissatisfaction was developing with the tendency of some asphalt pavements to shove and so lose smooth riding quality, the Institute Laboratory undertook to devise a method for measuring the resistance of asphalt paving mixtures to internal displacement. This investigation focused attention on the importance of proper compaction and succeeded in formulating a scientific basis for producing correct asphalt mixture designs, pre-tested as adequate, not only for paving highways but also for many *new* asphalt paving uses.

Two of these new uses, employing mixtures successfully designed and applied, were the installation of the asphalt bank mattress on the Mississippi River and the placing of hot asphalt mixtures to bind the under-water rubble and to cap the surface of the enormous Galveston Jetty. The U. S. Corps of Engineers and the Asphalt Institute cooperated in establishing these practical ways to control swollen rivers and protect storm-swept coasts.

### TEACHER, LECTURER AND AUTHOR

Prevost Hubbard's work as head of the Institute's research and laboratory, as presented here, is necessarily not even a complete outline biography. As teacher, lecturer and author, he has won world-wide recognition. On December 31, 1947, Mr. Hubbard retired from active duty with the Asphalt Institute but still, in general esteem both here and abroad, he is Dean Emeritus of Asphalt Research.

Testing the load-bearing capacity of asphalt pavement at Hybla Valley.

# HYBLA VALLEY RESEARCH PROJECT

## Tests of Asphalt Bases and Pavements

This is a research project of considerable magnitude sponsored cooperatively by the Highway Research Board, the U. S. Public Roads Administration, and the Asphalt Institute. Its broad objectives are as follows:

1. To obtain by means of field load bearing tests on full-size pavement sections, fundamental data on the load supporting value of asphaltic concrete pavement of various thicknesses, with respect to various base course thicknesses and degrees of subgrade support.
2. To correlate such field test data with appropriate laboratory tests, with the purpose of determining whether or not the latter may subsequently be used by themselves as the basis for a sound method for the design of pavements of the non-rigid type.

Spreading base course materials on the oval track.

The site of this track is at Hybla Valley, Virginia, not far from Mount Vernon. For the tests, the composition of *base courses* has been developed by the Public Roads Administration with the purpose of producing the best possible base from materials used. Asphalt Institute engineers designed the *asphaltic concrete* mixture and, as a design control measure, the Hubbard-Field Stability Test is employed.

To date, a great deal of pertinent information useful in the formulation of the testing program has been obtained and the investigation is being so planned that it will be possible to correlate the findings with all existing methods relating to pavement design.

The foregoing is technical language but it has a significance for the layman that can be measured both in terms of comfort and of dollars. *Under-designed* pavement leads to road failures, through no inherent fault of the asphalt; *over-design* involves unnecessarily high construction costs. Under-designed pavements are temporarily uncomfortable; but they can be rebuilt, from improved drainage up, without exorbitant expense. It is over-design of pavement that pinches the pocket-book. The unnecessary costs for building monuments to posterity, can run up the highway building bill by billions of dollars. "Roman Roads" a foot thick are no longer needed.

**INSTITUTE REPRINT PUBLICATION AVAILABLE**

An Asphalt Institute reprint publication, containing the Public Roads Administration's introductory report on this cooperative investigation, is available at the printing cost of 20c per copy. In writing any Institute Office ask for "Research Series No. 11."

Priming the base course.

Laying the asphalt surface.

*Pictures: Courtesy of U. S. Public Roads Administration.*

# OHIO STATE UNIVERSITY'S ASPHALT TENNIS COURTS

An ideal playground is the battery of forty-four asphalt-surfaced tennis courts on the Ohio State University campus, near the stadium, at Columbus, Ohio. The construction of this battery, one of the largest tennis layouts in the country, was started in 1934 with fifteen courts, increased in 1946 to thirty-nine and in 1947 to the present forty-four.

Although constructed at three different periods the designs for these courts, being satisfactory, were kept approximately the same. There is a pipe underdrain system with inlets between each two adjacent courts near the center so that surface water is promptly carried away. The cross-section design for the base, binder and top courses is as shown below.

Maintenance requirements have been slight. In 1943, the original fifteen courts were given a liquid asphalt seal coat of one-fifth gallon per square yard and apparently a light treatment of a similar nature occasionally is all that will be required to keep the surface in perfect playing condition.

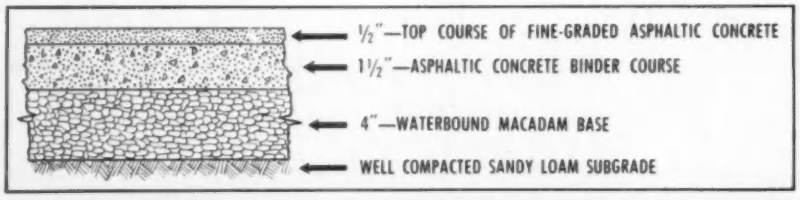
## ADVANTAGES OF ASPHALT COURTS

The good subdrainage system with ample inlets, combined with the smooth paved surface, prevents any pools of standing water. Storm water is removed and the courts are in a dry, clean condition suitable for playing promptly after a rain. This is in contrast to so many muddy surfaces which are very dirty for some time after a storm, frequently a serious handicap to the fullest use of the courts.

At the present time there are no breaks or cracks in the surface of these courts. They are smooth, nonskid, of pleasing gray color and hence easy on the eyes and most satisfactory for play. It would appear that for fast tennis asphalt surfaced courts are about the most perfect that can be built.

## VARIOUS SUITABLE TYPES

Various types, other than asphaltic concrete, are suitable for tennis courts, ranging all the way up from a thin surface treatment. A moderate expenditure will suffice to secure a good playing surface where funds are limited. By mixture with pigments, or using colored aggregate cover, a variety of colors may be obtained such as red, green and brown, if conformity to a particular color scheme is desired. Because a perfectly true, level surface is required, asphalt tennis courts should be constructed only by experienced workmen.


½"—TOP COURSE OF FINE-GRADED ASPHALTIC CONCRETE
1½"—ASPHALTIC CONCRETE BINDER COURSE
4"—WATERBOUND MACADAM BASE
WELL COMPACTED SANDY LOAM SUBGRADE

**INSTITUTE PUBLICATION AVAILABLE**

An Asphalt Institute publication, outlining tennis court surfacing fundamentals, is available at the printing cost of 10c per copy. In writing any Institute Office, ask for the booklet, "Construction Series No. 84."

OHIO: State Road 3, four miles east of Morrow. Pumping asphalt under rigid type pavement by use of three-way valve and return hose.

# Sub-sealing Rigid Type Pavements with Asphalt

Techniques are rapidly developing in many States to insure more effective resurfacing of old rigid type pavements through *subsealing* them with asphalt. Recent articles on the subject have reported such salvage work in California, Illinois, Indiana, Kansas, Maryland, Mississippi, Missouri, Ohio, Texas, Washington and West Virginia.

While procedures vary, the purpose is to find an effective seal to prevent water from seeping through the cracks and joints in the pavement to the subgrade. There is needed not only a seal but also an effective bearing foundation for the rigid pavement slab.

In general, asphalt subsealing consists of pumping highly viscous asphalt under the pavement slab at elevated temperatures for the purpose of filling underlying voids and cavities and placing a water tight membrane over the subgrade. Uniform support of the pavement is thereby re-established and the subgrade protected.

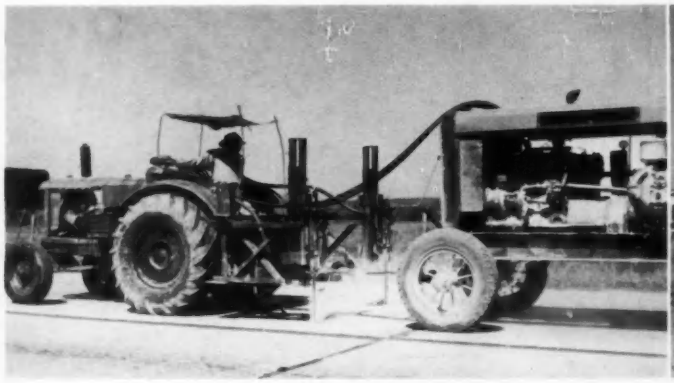
## AIRFIELD PAVEMENT SUB-SEALING

The practice of subsealing has also been in use on stations of the Air Training Command during the past three years, and has been commonly accepted as an efficient method of correction for rocking slabs, pumping joints and settlement.

The merits of subsealing as a preventive maintenance measure on airfield pavements were determined in comparative accelerated traffic tests conducted recently at Columbus, Mississippi, Air Force Base by the Air Installations Division of the U. S. Air Force. The test results provide a basis for determining how much the life of airfield pavement that had been subjected to traffic over a period of years, can be prolonged if subsealed prior to development of major distress, in comparison with similar but untreated pavement.

## NEW FIELDS OF USE

The subsealing process opens possibilities for sealing leaks through bridge abutments, retaining walls, tunnel or subway linings, mine shaft leakage, foundation leakage or sealing off leakage through dams. Experiments have already proved some of these "possibilities" to be realities, as the ingenuity of American engineers has been applied to them.



TEXAS: Tractor equipped with two air lift drills used for drilling 1½" holes in rigid type pavement for undersealing. The two drills are hinged just behind the tractor wheels and can be quickly moved to conform to any desired hole pattern.

CALIFORNIA: Strengthening rigid type of pavement on ramp at San Francisco International Airport by stabilizing with asphalt subsealing, to sustain Boeing Stratocruisers for their Oriental run. The runways at this airport are asphalt.

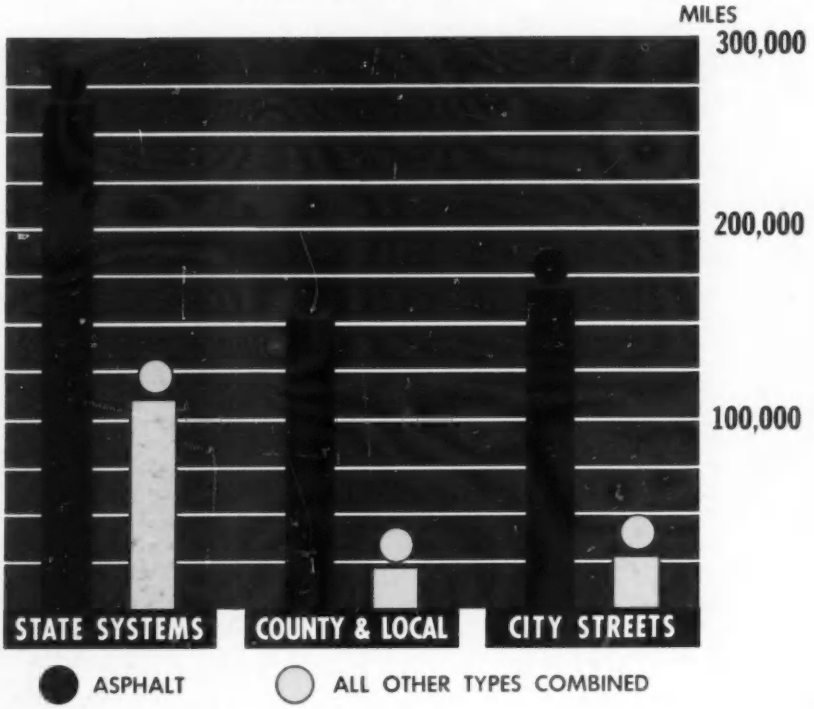
# Asphalt's Mileage Predominance in United States

In this picture combining a city street, a state highway, and a rural road there are represented, in general, the three classifications of U. S. asphalt paving that total in all over 500,000 miles. Graphically their mileage leadership over all competitive types is shown in the accompanying chart.

Asphalt meets the full range of surfacing requirements, whether the simple treatment of earth roads or paving of primary highways and streets which must carry the heaviest volume and weight of vehicular traffic. By reason of its inherent binding properties it can hold together a surfacing only one-half inch thick and yet withstand very considerable traffic; or it can be laid as a heavy-duty asphaltic concrete to form the smoothest, most durable, pavement known.

## TOTAL IMPROVED MILEAGE IN UNITED STATES

*(Surface Treated or Better)*



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